Dealing with demand

In the concluding part of the series on 100 years of ATM, Andrew Charlton explores the major reorganisation programmes of the last two decades.

The Second World War saw enormous step-changes in the size and reliability of airframes and of course, the jet propulsion engine. But without the quantum leaps made by air traffic control technology and procedures, modern aviation would look considerably different today.

The past 20 years have brought extraordinary growth in air traffic. Markets around the world have expanded and are now connected in ways unimaginable 100 years ago. But the air traffic control service paradigm, established after World War II, of voice communications, radio navigation and radar surveillance has sometimes struggled to scale up to meet the challenges of this rapid growth in demand.

In the late 1990s, the pressures on the system started to tell, with delays and congestion causing passenger disruption. In response, in 2004 the Single European Sky (SES) initiative was officially adopted by the European Commission to reform Europe’s air traffic management architecture.

At the same time, and in response to the same growth pressures, in the United States the Next Generation Air Transportation System (NextGen) programme was developed by the Federal Aviation Administration. Designed to modernise the national airspace of the United States, NextGen offers greater flexibility to pilots and air traffic controllers. NextGen developments are being implemented across the United States in several stages. These started in 2012 and will conclude in 2025.

A fundamental part of this proposed system is space-based automatic dependant surveillance-broadcast (ADS-B), which uses GPS satellite signals to provide accurate and stable information to ANSPs. This is nothing less than the satellite-based successor to radar. The data is of immediate use to the controllers but can also be streamed to the cockpits of properly equipped aircraft. Once implemented, this structure will allow the real-time display of air traffic for the first time, substantially improving safety.

Fit for purpose

The ambitious SES and NextGen projects are trying to speed up the process of innovation in a period when it is most needed. But there are many other projects underway to make the air transport system fit for purpose in its second century.

Probably the most significant work is being done by the International Civil Aviation Organization (ICAO), which has the task to coordinate, develop and implement its Global Air Navigation Plan. This framework defines the building blocks necessary for the upgrade and development of ATM systems and concepts around the world. These building blocks, called Aviation System Block Upgrades or ASBUs, are aimed at ensuring global upgrades proceed on a consistent and predictable basis, as each State moves along the development path at an appropriate pace.

In Asia Pacific, countries like Australia and Japan are also dedicated to developing strategic plans for the future of ATM consistent with the ASBUs.

Meanwhile, the inappropriate distribution of airport capacity across the globe is predicted to cause significant problems by 2035. While several major airports cannot easily continue to expand, some regional airports have overcapacity. As a consequence, by way of example, EUROCONTROL estimated that by 2035 approximately 12% of the demand for flights in Europe will have to remain unfulfilled. The causes of delay may be multiple (airport capacity, airspace capacity, weather...
disruptions) but the challenges of growth foreshadow a significant capacity gap in the coming 20 years.

Once again, the ATM system will be called on to find innovative technological solutions to overcome the issues caused by the predicted demand surge and to maintain the current high safety levels.

Air traffic flow management (ATFM) was developed to improve the operational side of aviation by using up-to-date flight information to anticipate future traffic demand across the entire network. First in the Command Center in the United States, and then with the Central Flow Management Unit in Europe, ATFM has become a fundamental part of managing and optimising congested airspace.

It’s all about the data

As with most other aspects of modern life, that cannot be done without access to appropriate data. Aeronautical information services (AIS) were introduced to maintain the flow of aeronautical information to both operators and controllers, ensuring that the most up-to-date and accurate information is available as flights are planned and operated. Most of the recent innovations in ATM, including area navigation implementation, performance-based navigation, airborne computer-based navigation and data link systems depend on accurate data.

As the data supply has moved to digital, and the understanding of how this information can be used dynamically has increased, it was recognised that ATM needed a global and interoperable provision of aeronautical data. Consequently, the concept of aeronautical information management built on AIS has been introduced. AIM monitors and controls the quality of the available information, providing the right mechanisms that support the ATM community in digitally managing the shared information.

Performance-based navigation (PBN) is a concept introduced in 2008 by ICAO to address airspace requirements. PBN allows the systematisation of air traffic through strategic separation of ATS routes. This decreases the need for tactical ATC intervention, allowing aircraft-to-aircraft separation to be “built-into” the airspace design, thereby enabling the migration from ATC to ATM. This allows the airline to have more flexibility to fly more direct routes.

Among the cutting edge changes of the last 25 years, reduced vertical separation minima (RVSM) is also noteworthy. It has made safe, optimised flying profiles accessible, with fuel savings and increased airspace capacity. In 1988, the ICAO Review of General Concept of Separation Panel completed the study that subsequently permitted the global standard of 1000-ft minimum vertical separation, from 2000-ft, above flight level 290.

Recent progress includes data replacing voice. In 2013, the controllers at Memphis International Airport started sending texts to FedEx Express pilots. Under the aegis of the SESAR programme, Europe too has seen trial flights that do not use the radio for voice communications at all.

The FAA is planning that by 2016 data communication will be used at ATC towers for sending pre-departure and revised pre-departure clearings. By 2019, this is expected to go further to air route traffic control centres for in-flight communication. Although voice messages will always be available for time-critical communication, a higher level of safety and improved efficiency are expected.